

Patent Application
Docket No. 27889-00037USPT

IN THE CLAIMS

Please amend the claims as follows.

1 ^{Sub I} 1. (currently amended) A cooling apparatus for removing heat from at least one heat
2 generating component, said cooling apparatus comprising:
3 a low profile metal unitary member comprised of one piece of metal, said low profile
4 unitary member having a first exterior surface adapted for receiving heat from the at least one heat
5 generating component and having a plurality of micro tubes formed of said one piece of metal having
6 a flattened heat transfer surface, said low profile metal unitary member having a micro tube inlet
7 comprised of said one piece of metal and a micro tube outlet comprised of said one piece of metal,
8 said low profile metal unitary member providing an entirely metallic thermal path for conducting heat
9 from said first exterior surface to a heat transfer fluid contained within said plurality of micro tubes,
10 said plurality of micro tubes being formed along an axis relative to said low profile unitary member;
11 ¹⁸ an inlet tube;
12 ^{28a} an cavities inlet end cap interconnecting the micro tube inlets in fluid communication
13 and connecting the micro tube inlets in fluid communication with said inlet tube;
14 ²² an outlet tube;
15 ²⁹⁶ an cavities outlet end cap interconnecting the micro tube outlets in fluid
16 communication and connecting the micro tube outlet in fluid communication with said outlet tube;
17 ~~said low profile metal unitary member being sealed by a first seal and a second seal~~
18 ~~for enclosing said low profile metal unitary member, said first seal being formed at said inlet end cap,~~

Patent Application
Docket No. 27889-00037USPT

19 ~~said second seal being formed at said outlet end cap, said first seal forming a first seal length and said~~
20 ~~second seal forming a second seal length;~~
21 ~~each of said plurality of microtubes being fluidly connected to adjacent and non-~~
22 ~~adjacent microtubes via said inlet end cap and said outlet end cap;~~
23 ~~means for circulating said heat transfer fluid through said inlet tube, said inlet end cap,~~
24 ~~the plurality of micro tubes of said low profile metal unitary member, said outlet end cap, and said~~
25 ~~outlet tube in a manner such that said fluid is injected into and ejected from said low profile unitary~~
26 ~~member parallel to said axis of said micro tubes; and~~
27 ~~means for removing heat from said heat transfer fluid.~~

1 2. (canceled)

1 3. (previously amended) The cooling apparatus of claim 2, wherein said member is in thermal
2 contact with the at least one heat generating component, and said member is further in direct contact
3 with said heat transfer fluid.

1 4. (previously amended) The cooling apparatus of claim 2, wherein said low profile metal
2 member is plated on an exterior surface with a metal material.

1 5. (previously amended) The cooling apparatus of claim 1, further comprising at least one
2 thermoelectric cooling unit disposed between the at least one heat generating component and said

Patent Application
Docket No.27889-00037USPT

3 first exterior surface.

1 *Sub*
Int
ent 6. (previously amended) The cooling apparatus of claim 1, wherein said low profile metal
2 member further comprises a plurality of fins on a second exterior surface opposite said first exterior
3 surface adapted for receiving heat.

1 7. (previously amended) The cooling apparatus of claim 1, wherein said low profile metal
2 member further comprises a plurality of fins or grooves on an interior surface of each of said plurality
3 of micro tubes.

1 8. (currently amended) A cooling apparatus for removing heat from at least one heat
2 generating component, said cooling apparatus comprising:

3 a low profile unitary member having a flattened exterior extrusion surface adapted for
4 receiving heat from the at least one heat generating component and a plurality of micro tubes with
5 a micro tube inlet and a micro tube outlet, said plurality of micro tubes being formed along an axis
6 relative to said low profile unitary member;

7 *Fig. 8 /* at least one fin on an interior surface of at least one of said plurality of micro tubes;

8 an inlet tube;

9 an cavited inlet end cap interconnecting the micro tube inlets in fluid communication

10 and connecting the micro tube inlets in fluid communication with said inlet tube;

11 an outlet tube;

Patent Application
Docket No. 27889-00037USPT

12 *Sub*
13 *1-ent* a cavities outlet end cap interconnecting the micro tube outlets in fluid communication
14 and connecting the micro tube outlet in fluid communication with said outlet tube;

15 means for circulating a heat transfer fluid through said plurality of micro tubes of said
16 low profile member in a manner such that said fluid is injected into said low profile unitary member
17 and ejected from said member parallel to the axis of said micro tubes; and

means for removing heat from said heat transfer fluid.

Hg
1 9. (original) The cooling apparatus of claim 8, wherein each of said micro tubes are
2 substantially rectangular in shape.

1 10. (previously amended) The cooling apparatus of claim 8, wherein said low profile member
2 is formed of a metal material.

1 11. (previously amended) The cooling apparatus of claim 10, wherein said metal material is
2 in thermal contact with the at least one heat generating component, and said metal material is further
3 in direct contact with said heat transfer fluid.

1 12. (previously amended) The cooling apparatus of claim 8, further comprising at least one
2 thermoelectric cooling unit disposed between the at least one heat generating component and said
3 first exterior extrusion surface.

Patent Application
Docket No.27889-00037USPT

Sub
T
ent

1 13. (previously amended) The cooling apparatus of claim 8, wherein said low profile
2 extrusion further comprises at least one fin on an interior surface of each of said plurality of micro
3 tubes.

1 14.-20. (canceled)

1 21. (currently amended) A cooling apparatus for removing heat from at least one heat
2 generating component, said cooling apparatus comprising:

172
ent

3 a low profile metal unitary member comprised of one piece of metal having a first
4 exterior extrusion surface adapted for receiving heat from the at least one heat generating component
5 and a plurality of micro tubes with a micro tube inlet comprised of said one piece of metal and a micro
6 tube outlet comprised of said one piece of metal, said plurality of micro tubes being formed along an
7 axis relative to said low profile unitary member, said low profile metal unitary member providing an
8 entirely metallic thermal path for conducting heat from said first exterior extrusion surface to a heat
9 transfer fluid contained within said plurality of micro tubes, said member having a profile of less than
10 approximately 0.1 inches;

11 an cavities inlet end cap interconnecting the micro tube inlets in fluid communication;

12 an cavities outlet end cap interconnecting the micro tube outlets in fluid
13 communication;

14 ~~_____ said low profile metal unitary member being sealed by a first seal and a second seal~~
15 ~~for enclosing said low profile metal unitary member, said first seal being formed at said inlet end cap,~~

Patent Application
Docket No. 27889-00037USPT

16 ~~sub~~ ~~1~~ ~~ent~~ said second seal being formed at said outlet end cap, said first seal forming a first seal length and said

17 second seal forming a second seal length;

18 each of said plurality of micro tubes being fluidly connected to adjacent and non-
19 adjacent micro tubes via said inlet end cap and said outlet end cap;

20 means for circulating said heat transfer fluid through said inlet end cap, the plurality
21 of micro tubes of said low profile extrusion and said outlet end cap in a manner such that said fluid
22 is injected into said low profile unitary member and ejected from said member parallel to the axis of
23 said micro tubes; and

24 means for removing heat from said heat transfer fluid.

1 22. (previously amended) The cooling apparatus according to claim 21 wherein:

2 said cooling apparatus is affixed to a printed circuit board for cooling the heat
3 generating component.

1 23. (previously amended) The cooling apparatus according to claim 1 wherein:

2 said cooling apparatus is affixed to a printed circuit board for cooling the heat
3 generating component.

1 24. (previously amended) The cooling apparatus according to claim 8 wherein:

2 said cooling apparatus is affixed to a printed circuit board for cooling the heat
3 generating component.

Patent Application
Docket No.27889-00037USPT

Sub
List

1 25. (original) The cooling apparatus according to claim 1, wherein each of said micro tubes
2 are polygonal in cross section.

1 26. (original) The cooling apparatus according to claim 1, wherein each of said micro tubes
2 are substantially square in cross section.

1 27. (original) The cooling apparatus according to claim 8, wherein said micro tubes are
2 polygonal in cross section.

1 28. (original) The cooling apparatus according to claim 8, wherein said micro tubes are
2 substantially square in cross section.

1 29. (original) The cooling apparatus according to claim 21, wherein said micro tubes are
2 polygonal in cross section.

1 30. (original) The cooling apparatus according to claim 1, wherein said micro tubes are
2 substantially square in cross section.

1 31. (original) The cooling apparatus according to claim 21, wherein said micro tubes are
2 substantially square in cross section.

Patent Application
Docket No. 27889-00037USPT

Sub
T-1
ent

1 32. (original) The cooling apparatus according to claim 1 wherein:
2 said member has a profile of approximately 0.1 inches.

1 33. (original) The cooling apparatus according to claim 8 wherein:
2 said member has a profile of approximately 0.05 inches.

1/2
ent

1 34. (original) The cooling apparatus according to claim 1, wherein said micro tubes have a
2 diameter of between approximately .0625 inches and 0.5 inches.

1 35. (original) The cooling apparatus according to claim 8, wherein said micro tubes have a
2 diameter of between approximately .0625 inches and 0.5 inches.

1 36. (original) The cooling apparatus according to claim 21, wherein said micro tubes have
2 a diameter of between approximately .0625 inches and 0.5 inches.

1 37. (original) The cooling apparatus according to claim 21, wherein said low profile is
2 approximately 0.05 inches.

1 38. (original) The cooling apparatus according to claim 21 further comprising:
2 at least one fin on an interior surface of each of said plurality of micro tubes.

Patent Application
Docket No. 27889-00037USPT

No new matter has been added.